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EXPANSION OF STAMFORD/NIAGARA FALLS WATER POLLUTION CONTROL PLANT AND REDUCTION OF INDUSTRIAL LOADINGS

by
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The Stamford/Niagara Falls water pollution control plant was constructed jointly by the City of Niagara Falls and the Township of Stamford in 1961 and 1962. It was placed in operation in 1963, after the amalgamation of the two municipalities, to provide expanded sewage treatment service to the City of Niagara Falls. The consulting engineers were H. G. Acres International Limited and the plant was designed to provide primary treatment to a flow of 10 million imperial gallons per day. Sludges from the digesters were directed to lagoons where they were decanted. The material was later spread on adjacent land and air dried. The dried sludge was used for various agricultural purposes.

In 1975 the plant was physically doubled, Gore & Storrie Limited were the consulting engineers. Because of high storm flows during rain periods and phosphate removal requirements, the Ministry of the Environment rating of the plant was only increased to 12 (MIGD) million imperial gallons per day.

In January 1983, we received an inquiry from Mr. A. MacBain, then Member of Parliament for Niagara Falls, in respect to possible environmental projects in which the federal government could participate. We suggested the possibility of providing secondary treatment at the Stamford/Niagara Falls water pollution control plant. Our estimated cost for providing the facility at that time was in the order of $25 million.

Mr. MacBain was successful in obtaining a federal grant of $4 million and we approached the Province of Ontario requesting a similar grant. The province agreed to a grant of $3.85 million, providing we could develop a design and system with an overall capital expenditure of $12 million. The province also required that, in order to prevent overloading the plant, all food processing and beverage industries be required to reduce their discharge of overstrength wastes to sewer-use bylaw limits within a five-year period or by 1990. In 1983, the average flow at the plant was 12 MIGD with peak flows up to 23.5 MIGD on a maximum day.

We engaged the firm of Pollutech Inc. to undertake a process study to determine the most effective means of providing treatment for the sewage received. At the Niagara Falls plant, the sewage is quite normal for an eight- to nine-month period, but during the months of August, September, October, and part of November, strong sewage effluents are received from food and beverage industries. A procedure had to be developed to handle this shock loading. Pollutech Inc. undertook a three-month pilot plant program, between July 15 and November 17, 1983 and they developed data for waste characteristics.

They found the sewage from November through August to be similar to that found across the province for sanitary sewer systems. From August through November, the loadings increased extensively. Their rotating biological contactor pilot plant produced an effluent having both total $B.O.D._5$ (biochemical oxygen demand) and suspended solids of less than 15 milligrams per litre, operating on an organic loading of less than 2.2 lbs. of $B.O.D._5$ per 1,000 ft^2.

After very careful consideration of the technical report of Pollutech Inc. and their evaluation of various alternatives, it appeared that the most economic and best technical route was to proceed with rotating biological contactors for the plant. We therefore adopted this recommendation.

There were a number of installations in Canada; one in Guelph (tertiary only), several in Ontario and Saskatchewan, but they were quite small in comparison to our proposal, and are generally one-stage treatment. Our consultants and staff examined similar operations in the United States and it was our staff's opinion that we could make the system operate at the Stamford/Niagara Falls plant.

We encountered difficulty obtaining Ministry of the Environment approval for this project but because of the urgency of the Niagara River Toxics Committee report, which was then underway, and the publicity related to the availability of federal funding, we were given approval to proceed because of pressure from the minister's office. Our civil consultants were Gore & Storrie Ltd. and the successful contractor on this project was Pigott Construction. The construction consisted of 35 rotating biological contactor units, followed by secondary clarification and chlorination prior to discharge to the Ontario Hydro canal, which discharges to the Niagara River.

As a result of fast track construction, with able assistance of Gore & Storrie Ltd., we were able to take this project from conception to reality in two years.

As a condition of approval, the Ministry of the Environment required that food and beverage processing industries

reduce their suspended solids and B.O.D. loadings to the sanitary sewer system to our sewer-use bylaw limits within a five-year period (see Appendix "A"). We determined there were eight industries that fell into this category. These eight industries were issued control orders in 1984 requiring them to bring their waste discharges to the local sanitary sewer system in compliance with the Regional Municipality of Niagara Sewer Use Bylaw No. 3308-83 by 1990. Each industry was requested to provide a program for compliance by December 31, 1984. The program was to include a timetable giving specific dates for various phases under the program, such as design, tendering and construction.

The Niagara Region adopted its first Sewer-Use Bylaw in 1972. Like most sewer-use bylaws of this time, its main emphasis was on conventional parameters such as B.O.D. (biochemical oxygen demand), suspended solids, oil and grease, pH and a limited number of metals.

In 1976 this bylaw was revised to include a surcharge for companies whose wastes exceeded the bylaw's limits for B.O.D. and/or suspended solids and yet whose wastes could still be readily handled by the local sewage treatment plant.

This bylaw was primarily based on a model sewer-use bylaw developed by the Ontario Ministry of the Environment and the Municipal Engineering Association. As Niagara was also faced with the new "Provincial Guidelines for Sewage Sludge Utilization on Agricultural Lands", stricter controls on metals were also incorporated into the bylaw at this time. (See Appendix "A")

The current bylaw was adopted in 1983 in order to reflect minor changes in "The Regional Municipality of Niagara Act", which is the provincial legislation enabling Niagara to pass and enforce such bylaws.

It is believed that by mid-1988 the final version of a new model sewer-use bylaw will be received from the province. This bylaw will be the first attempt to address the public's concern for toxic chemicals, the majority being organic (carbon based) in nature.

Once this bylaw is reviewed, it will be incorporated with other changes currently under consideration by staff and submitted to our council for approval. One of these changes will likely include a substantially increased fine structure for offenders and the possibility of charging individuals if the enabling legislation is passed by parliament.

There is little doubt that the public's increasing awareness and concern with the accumulation of toxic chemicals in the environment, as well as our ever increasing knowledge of their effects, will require far more frequent bylaw revisions and much stricter methods of enforcement.

Before the control order was issued, Regional staff met with each of the industries to explain why a control order was necessary. In addition, the Regional Chairman, on June 4, 1984, sent a letter to each industry explaining financial requirements for sewage plant expansion and Ministry of the Environment requirements for industry to bring their effluent in compliance by 1990. He offered to arrange meetings

with a committee organized to attend such meetings. This committee consisted of representatives from Regional Council, including the Regional Chairman, Regional staff, City of Niagara Falls mayor and staff, and a representative from the Ministry of the Environment.

One of the very first complaints received from industry was that this requirement was not being made in other jurisdictions where their competition was located, and that they were being placed in an unfortunate position. Fortunately, the representative from the Ministry of the Environment was able to indicate that this was not the case and was of considerable assistance to us at these meetings.

The first industry, which was a beverage industry, objected very strongly to our order, particularly to the fact that we had not met with them previously. At our initial meeting, this firm rejected requirements of the control order. As a result of Ministry of the Environment input, they engaged consultants and by the spring of 1985, advised they were prepared to comply with our requirements. In 1988, they propose to call their consultants back in to determine if equalization of their wastes is now feasible. They have substantially reduced their waste discharge since receiving their 1985 consultants report and now believe they can comply with the sewer-use bylaw through equalization.

The second industry was a food industry. Upon receiving our control order, they employed a consulting firm and quickly determined that they were losing product which was causing their high organic discharge. As a result, in December 1984, they provided a report to us on an implementation reduction program through product recovery and re-use.

In checking with this firm on April 4, 1988, we discovered that the previous plant manager was no longer there. Staff at the plant admitted that for the past two years nothing was really done about the control order because of the possibility that the company might be sold. The new manager advises that they are now committed to an $8 million plant expansion and have hired a local engineering firm to prepare plans and specifications for pollution control in order that they may meet our control order by 1990, as previously promised.

The third firm was a beverage firm and upon receipt of our order, they engaged consultants to determine possible alternatives. At a meeting with our committee, they expressed concern with the cost to provide additional inhouse treatment facilities and indicated it would make their operation less economical, forcing them out of business.

In checking with this firm on March 31, 1988, they indicated that they will continue to improve inplant control to reduce the amount of material discharged to the sanitary sewer system. They are planning a $1 million expansion and have included in their capital budget a lagoon in 1990 in order to meet our effluent requirements. A decision on whether to proceed with the lagoon or not will be made in 1989.

The fourth firm was a food processing industry and they initially ignored our order until a further letter was sent late in 1984. They expressed concern with the requirements in view of their poor financial position over the last few years. In 1985, they engaged a consulting engineering firm to carry out an engineering study and report on a program of compliance.

In checking with this firm on April 4, 1988, they advised that they had a new plant engineer and have provided $60,000 in their 1988 budget to engage a consulting firm which they hope will solve their problems. It is their opinion, that by improving their screening, they can reduce B.O.D. and by further plant improvement, they can meet our bylaw requirements. We requested that they put their proposals in writing so these can be reported to our Public Works and Utilities Committee.

The fifth industry was also a food processing firm. They immediately acknowledged our order, requested additional information and a copy of our consultants report. They wrote to our chairman in 1984, expressing concern about the cost of providing the necessary treatment. By December of 1984, they provided an outline of their effluent treatment proposals for complying with our bylaw by 1990. All of their work was done by inhouse staff.

By April 6, 1988, this company had gone as far as they could with chemical treatment (polymers and catalysts). They were still peaking at 1,400 milligrams per litre B.O.D., an average of 800 milligrams per litre B.O.D. The firm is now looking at separating their process streams and, where needed, treating them before they reach the dissolved air-flotating system. Also, they are examining screening wastes before they reach the wet well in order to prevent large solids from dissolving when the sewage is retained in the well.

This firm admitted they are facing a similar problem at their California plant and now realize that most of their problems with B.O.D. is due to blanchers because of high starch content (pasta). They are now consistently below the bylaw for suspended solids. They advise they will send us a further report on their activities in September of 1988.

The sixth industry was a food and beverage processing industry. Upon receipt of our order, they engaged a consulting firm. The industry was purchased by an international firm, who immediately advised that they would be in compliance with our bylaw by 1990. They indicated the course of action proposed. Unfortunately, because of marketing problems, this industry went out of business in 1987.

The seventh industry was a food processing industry which caused considerable problems in the past. They were purchased by a national industry and immediately reported to us on a program for compliance. They were almost in full compliance with our bylaw by 1985. They now propose to add a dissolved air flotation unit in 1988 in order to ensure that this will meet our bylaw requirements.

The eighth firm was a small food processing firm and they initially refused to co-operate with us. In February 1985, they wrote a letter to us advising they had nothing to report and that the estimate for compliance was a prohibitive cost for their company. They met and expressed their concerns to the mayor and local Members of Parliament and requested, through those sources, financial assistance.

On April 6, 1988, our staff contacted this firm again and they advised the Ontario Research Foundation has acquired technology on a type of membrane which will remove protein (solids), and that they are arranging for the system to be built in Canada. The manager advised that he was very pleased to find that he could actually sell the solids he recovered and apparently there is quite a market for these. He is quite satisfied that the equipment will do the job and agreed they will meet our bylaw by 1990.

By May 1987, the first firm had acquired other companies in Niagara region, and were working on a corporate policy. They advised that they had reduced their average B.O.D. and suspended solids by one-half and were introducing other measures. They have assured us that they will meet our bylaw by 1990.

Industry No. 2 carried out inplant measures to reduce waste loadings and it appears that their wastes are now within bylaw limits. Problems occurred because of staff changes, but with a proposed plant expansion, this will provide satisfactory equipment for pollution control.

Industry No. 3 hired a consultant and are considering their report. They indicated they want a further meeting with local political representatives and this will probably be arranged in the near future. It now appears they will build a lagoon in 1989 to resolve their effluent problem.

Industry No. 4 was debating whether to spend money on a pollution control system or close operations. It now appears with inplant improvements, that they will meet our bylaw.

Industry No. 5 did not hire a consultant but undertook considerable work with their own staff and are making progress. Since they are working on a similar problem at another plant in the United States, we anticipate they will solve their problems.

Industry No. 6 operated during 1986 but closed in 1987. Since they had a major impact on the pollution control plant, this certainly will reduce loading.

Industry No. 7, although giving us a very difficult time initially, is now in total compliance with the bylaw, 90% of the time. By 1990, they should be in compliance 100% of the time.

It now appears that industry No. 8 will be in compliance by 1990, provided they receive assistance they expect from the Ontario Research Foundation.

For testing of effluent, we request all industries in Niagara to do their own sampling and forward these samples to their own laboratory. We request that a copy of the test results be forwarded directly from the industry's selected laboratory to us. This information is used to determine surcharges where these are applicable and to assure that industries are meeting our bylaw requirements. We also request that all industries locate a manhole either at their property line or on the road allowance adjacent to their property, where we can take grab samples in order to monitor flows.

In general we found industries to be very co-operative, their sampling fair and objective; our system of allowing industries to do their own testing has worked out very well.

In October 1984, the report of the Niagara River Toxics Committee was made public. The Niagara Falls water pollution control plant was identified in the report of this committee as a source of priority pollutants at a rate of 24.3952 kilograms per day. As a result of provision of secondary treatment with rotating biological contactors, these priority pollutants have been reduced to 3.9001 kilograms per day, which is well within present allowable limits.

Construction of the pollution control plant was completed and it was placed in operation on December 20, 1985. We engaged Pollutech Inc. to provide us with one year of monitoring and to prepare a manual of instructions to properly operate the RBCs (rotating biological contactors).

The Rotating Biological Contactor (RBC) system is a rotating fixed film biological process that relies on biomass attached to a plastic media to extract soluble organic matter from the primary effluent. The soluble organics are converted to biomass by the living organisms through cell reproduction. The excess biomass is then sloughed off the media and collected in the secondary clarifiers. Oxygen, necessary to complete the biological process, is attained from the liquid media with alternate exposure of the biomass to the atmosphere and waste. This biological process is similar to conventional activated sludge in terms of biomass growth and harvesting, but differs in that biomass is "attached" not "suspended".

Primary effluent is fed to five (5) process trains and thereafter the influent is treated in a plug flow manner through four (4) stages of each train. Each shaft removes incremental amounts of soluble $B.O.D._5$ through conversion of organics to all biomass. The total RBC facility of 3,710,000 ft^2 can accommodate an organic load of approximately 8,160 pounds of $B.O.D._5$ per day at the 2.2 lb/1000 ft^2 load. The influent flow must be varied to ensure that the total organic loading is not exceeded on a continuous basis. Dissolved oxygen levels of 1.0 mg/L or greater in the first stage are a good measure that organic overloading is not being experienced.

To allow for optimized operation of the RBC facility during all periods of the year, we have an ongoing testing procedure on a monthly, weekly, daily and shift basis as follows:

-- monthly recording of weights on all 35 RBC shafts;

-- daily recording of weights on all Stage 1 RBC shafts;

-- daily recording of dissolved oxygen levels in all 35 RBC shafts;

-- shift recording of dissolved oxygen levels in all Shaft A, RBC units;

-- daily recording of visual characteristics of all shafts biomass as per established procedures

On initial start up, a complete inspection of RBC equipment was implemented. Media surface and joints must be checked regularly while initial biomass growth is occurring. We found that in our installation, sections of the media were loose due to improper sizing of the grommets used to anchor the media to the spider and shaft assembly. It is imperative that the units be revolving when raw sewage is introduced to the RBC trains, as an imbalanced situation on start up can occur very quickly. We find that this took less than two (2) hours. We experienced major motor problems, resulting in frequent motor repairs at startup. If any repair takes longer than two hours, maintenance staff rotate the RBC by hand one revolution per hour until completion of the job.

Motor failures experienced were due to little or no radial load on the non-drive end bearings. The motors have die-cast bearing castings with a steel sizing sleeve cast into the housing. This steel bearing seat is not a full circle. This means that the size of the bearing housing is controlled by a zinc die-cast casting. Given that the two metals have a difference in co-efficient liner expansion, it appears that an additional .001 inch of clearance develops in the bearing housing at operating temperature.

Several methods to rectify this situation have been tried including re-machining the housings and installing tolerance rings and also a complete replacement of non drive end housings. After endless correspondence and meetings with Regional staff, the manufacturer, U.S. Motors, finally agreed to a total replacement with a different motor. They supplied a heavy duty motor and it has solved this problem.

Referring to the process, we pay careful attention to biomass colour and odour as we found that the relationship between these factors, B.O.D. loading temperature and D.O.s (dissolved oxygen) are extremely helpful in determining the daily status of the system.

In conjunction with the Process Consultants, Pollutech, we experimented with the RBC system by introducing additional air in one train, step-feeding in another train and also regulating different flows for comparison in the remaining trains.

We also try to maintain a low sludge blanket in our final clarifier. We found by experience that returning sludge to the primaries was causing an overload situation at RBC sections. Hence, we pump our final clarifier waste directly to the digestors. This procedure will be reviewed with the process consultants after a year of experience.

Another problem encountered with RBC's was opposition from Ministry of the Environment staff. Perhaps it was felt that we used undue pressure in obtaining initial approval by meeting with the Minister of the Environment. After initial startup, Ministry of the Environment staff visited our plant. They were unduly critical of the operation and, in our opinion, without justification. We requested a further meeting with Ministry of the Environment staff, bringing in our consultants and our own staff to answer all questions.

Our staff and consultants were able to answer all questions and we demonstrated that our effluent met ministry requirements. The only problem they left with us was the fact that some members of the ministry did not like the colour of the algae strains within some of the RBC's.

Opposition of ministry staff surfaced in a speech made by the minister when he indicated there was an operational problem at the Niagara Falls plant. As a result, we sent the minister a report, prepared by our consultants, Pollutech, which indicated we were able to achieve the required effluent results in 1986 even with all food and beverage industries working at full capacity during the fall of 1986.

This problem was further discussed at Regional Engineers' meetings with senior staff of the Ministry of the Environment and, in my opinion, has now been resolved. Ministry staff are now much more willing to look at new ideas and new concepts and we have been successful in presenting and receiving acceptance of process studies at other plants where construction is proposed. This has resulted in both capital and operational cost savings for this municipality. We have found suggestions made by ministry staff very helpful and they are now most co-operative.

We were able to construct a plant with good operational characteristics; sensitive to operational requirements and providing improved effluent as required by the Ministry of the Environment's Certificate of Approval, at a minimum cost. By use of RBC's we have been able to reduce our initial estimated cost of $25 million to $12 million, to provide a plant capacity of 15 MIGD per day while still producing sludges which we can dispose of on farm lands, and an effluent well within the limits of our Certificate of Approval (that is an effluent objective of 15 parts per million B.O.D., 15 parts per million suspended solids, and 1 milligram per litre phosphorus with a non-compliance limit of 25-25-1).

With today's requirement for environmental approval and the need of keeping escalating costs down, it is very important that innovative ideas and processes be encouraged and not suppressed.

In summary, our experience was that governments and to some extent industries are suspicious of change. Industries, in many cases, cannot relate their discharges to municipal sewer systems, or to pollution as it exists in the Great Lakes ecosystem. Some believe tax-supported governments should solve all pollution problems without any disruption of manufacturing processes. We have proven that common sense negotiations and sensible guidelines can be sold to those who were most adamant. We have also proven that process studies pay off. It is well to remember that Ministry of the Environment guidelines are just that. They are not carved in stone, nor should they be tatooed on the minds of their officials. Process studies rarely fail to show the way. Because waste is as individual as the people who create it, methods of treatment can be just as varied. New technology will never have a chance without governments willing to become pioneers in pollution clean up. Thankfully, Ontario has accepted this challenge.

THE REGIONAL MUNICIPALITY OF NIAGARA

EXCERPT FROM
BILL 3271
SEWER USE BYLAW No. 3308-83

4. USE OF SEWERS:

(1) No person shall discharge into any Regional Sewage Works or into any sewer or sewer system connected directly or indirectly with any Regional Sewage Works, any matter or quantity of matter which may be harmful to or may become harmful to such sewage works, or which may interfere with their proper operation, or which may impair or interfere with any sewage treatment process, or which may obstruct or may tend to obstruct any sewer, or which may be or may become a hazard to persons, property or animals, or without limiting the generality of the foregoing, any of the following:

(a) sewage containing more than a total of 100 milligrams per litre of oil, fat and grease of animal and vegetable origin;

(b) sewage containing more than a total of 15 milligrams per litre of oil, grease and tar of mineral or synthetic origin;

(c) sewage at a temperature in excess of 65 degrees Celcius (149° Fahrenheit);

(d) subject to subparagraph (b) hereof, flammable or explosive matter, and without limiting the generality of the foregoing, gasoline, benzene, naptha, fuel oil, acetone or other solvents;

(e) any quantity of matter capable of obstructing the flow in or interfering with the proper operation of any part of the sewage works, and without limiting the generality of the foregoing, any such quantity of ashes, cinders, sand, straw, mud, shavings, metal, glass, rags, feathers, plastic, wood or cellulose;

(f) sewage having a pH less than 6.0 or greater than 10.5 or which due to its nature or content becomes less than 6.0 or greater than 10.5 within a sewage works;

(g) sewage of which the B.O.D. exceeds 500 milligrams per litre;

(h) sewage in which suspended solids exceed 500 milligrams per litre;

(i) sewage that may cause a nuisance, and without limiting the generality of the foregoing, sewage containing hydrogen sulphide, carbon disulphide, ammonia, trichloroethylene, sulphur dioxide, formaldehyde, chlorine, bromine, or pyridine, in such quantity that an offensive odour could emanate from the sewage works or could cause a nuisance;

(j) sewage containing animal waste, and without limiting the generality of the foregoing, containing intestines, stomach casings, intestinal contents, hides, hooves, toenails, horns, bones or poultry heads or sewage containing hair, wool, fur, feathers, paunch manure or fleshings in a quantity sufficient to interfere with the proper operation of the sewage works;

(k) any garbage, except from garbage disposal units or grinders, or any food waste which has not been properly shredded so that all particles will be carried freely under flow conditions normally prevailing in public sewers.

(l) sewage containing any of the following matter in excess of the indicated concentrations:

Matter	Expressed as	Concentrations in Milligrams per litre
Aluminum	Al	50
Arsenic	As	1.0
Barium	Ba	5.0
Cadmium	Cd	2.0
Chloride	Cl	1500
Chromium	Cr	5.0
Copper	Cu	5.0
Cyanide	HCN	1.0
Fluoride	F	10
Iron	Fe	50
Lead	Pb	5.0

Matter	Expressed as	Concentrations in Milligrams per litre
Mercury	Hg	0.1
Nickel	Ni	5.0
Phenolic compounds		1.0
Phosphorus	P	100
Sulphate	SO4	1500
Sulphide	S	2.0
Tin	SN	5.0
Zinc	Zn	5.0
Pesticides		0.0
Herbicides		0.0

(m) radioactive materials except as may be permitted under The Atomic Energy Control Act, R.S.C., 1970 and amendments thereto and regulations thereunder.

(n) storm water, water from drainage of roofs or land or from a watercourse, or uncontaminated water except that which may be discharged into a combined sewer.

(o) sewage which consists of two or more separate liquid layers.

(p) regardless of any limitations set forth in this bylaw, any quantity of matter which may hinder or prevent the disposal or application of sewage sludges on land due to limitations set forth in the current "Provisional Guidelines for Sewage Sludge Utilization on Agricultural Lands" as prepared by the Joint Ministerial Committees of the Ontario Ministry of Agriculture and Food, the Ontario Ministry of the Environment, and the Ontario Ministry of Health.

4. (2) If, in the opinion of the Director, an interceptor is necessary for the removal of grease, flammable wastes, sand or other harmful ingredients, such interceptor shall be in accordance with the standards and specifications of the Director and shall be in location easily accessible for cleaning and inspection.


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